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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte NACE LAYADI
and SIMON JOHN MOLLOY

Appeal 2009-004931
Application 09/905,398
Technology Center 2800

Decided: September 30, 2009

Before CHARLES F. WARREN, PETER F. KRATZ, and
MARK NAGUMO, *Administrative Patent Judges*.

WARREN, *Administrative Patent Judge*.

DECISION ON APPEAL

Applicants appeal to the Board from the decision of the Primary Examiner finally rejecting claims 1 through 5, 7, and 19 through 21 in the Office Action mailed April 14, 2004. Appellants state “Claims 19-20 are not appealed.” Br. 2. We dismiss the appeal with respect to claims 19 and 20, leaving claims 1 through 5, 7, and 21 for consideration on appeal.

35 U.S.C. §§ 6 and 134(a) (2002); 37 C.F.R. § 41.31(a) (2005).

We affirm the decision of the Primary Examiner.

Claim 1 illustrates Appellants' invention of a semiconductor structure, and is representative of the claims on appeal:

1. A semiconductor structure comprising:

a substrate having a device feature formed thereon;

a dielectric layer disposed over said substrate and device feature and having at least one contact hole formed therein;

a polish stop layer disposed over the dielectric layer and extending within the contact hole;

a layer of metal disposed over the polish stop layer within the contact hole and forming a plug; and

wherein said polish stop layer comprises titanium aluminum nitride.

The Examiner relies upon the evidence in these references (Ans. 2):

| | | |
|------------------------|---------------|---------------|
| Meikle | US 5,231,306 | Jul. 27, 1993 |
| Yamashita ¹ | JP 4-107148 A | Apr. 23, 1996 |

Appellants request review of the grounds of rejection under 35 U.S.C. § 103(a) advanced on appeal by the Examiner: appealed claims 1 through 5, 7, and 21 over Yamashita in view of Meikle.² Br. 3; Ans. 3.

Appellants argue independent claims 1 and 21 as representative of the claims in the ground of rejection. Br. 3 and 5. Thus, we decide this appeal based on claims 1 and 21. 37 C.F.R. § 41.37(c)(1)(vii) (2005).

¹ We refer to a computer translation of Yamashita prepared by the Japanese Patent Office. Appellants do not dispute the information in this translation. See generally Br.

² We have not considered the Wolf document discussed at page 7 of the Answer which has not been included in the statement of the ground of rejection advanced on appeal. See *In re Hoch*, 428 F.2d 1341, 1342 n. 3, (CCPA 1970); cf. *Ex parte Raske*, 28 USPQ2d 1304, 1304-05 (BPAI 1993).

Issue

The issue in this appeal is whether Appellants have shown that the evidence in the combined teachings of Yamashita in view of Meikle does not support the Examiner's conclusion of *prima facie* obviousness with respect to the claimed semiconductor structure encompassed by claims 1 and 21.

Claim Interpretation

The plain language of independent claim 1 encompasses any semiconductor structure comprising at least any substrate having any device feature formed thereon; any dielectric layer disposed on said substrate and device feature having at least one contact hole; a polish stop layer comprising at least any titanium aluminum nitride alloy (TiAlN alloy) disposed over the dielectric layer and extending into the contact hole; and any metal layer disposed over the layer comprising at least TiAlN alloy within the contact hole and forming a plug. The layer comprising at least TiAlN alloy must be capable of functioning as "a polish stop layer" in at least one chemical mechanical polishing (CMP) process without limitation on the CMP step(s) employed. *See Spec.*, e.g., 1 and 3. In similar manner, independent claim 21 specifies any semiconductor structure comprising at least any metal layer disposed on any substrate; a layer of any titanium aluminum nitride alloy disposed on the metal layer; any dielectric layer disposed on the layer of TiAlN alloy; and any patterned layer of photoresist disposed on the dielectric layer exposing a portion of the dielectric layer to at least one etching process without limitation on the chemical and mechanical step(s) employed. The layer of TiAlN alloy must be capable of

functioning as “an etch stop layer” upon removal of at least a portion of the dielectric layer by the etching process to “prevent the etching layer from compromising the underlying metal layer.” We interpret the latter claim language as requiring the TiAlN alloy layer to stop the effect of the etching process to the extent the etching process is not detrimental to the metal layer. *See Spec.*, e.g., 3. *See, e.g., In re ICON Health and Fitness, Inc.*, 496 F.3d 1374, 1378-79 (Fed. Cir. 2007); *In re Am. Acad. of Sci. Tech Ctr.*, 367 F.3d 1359, 1364 (Fed. Cir. 2004), and cases cited therein; *In re Morris*, 127 F.3d 1048, 1054-55 (Fed. Cir. 1997).

The transitional term “comprising” opens claims 1 and 21 to include semiconductor structures having any manner of additional materials and layers. *See, e.g., Exxon Chem. Pats., Inc. v. Lubrizol Corp.*, 64 F.3d 1553, 1555 (Fed. Cir. 1995); *In re Baxter*, 656 F.2d 679, 686 (CCPA 1981). The claimed semiconductor structure encompassed by claims 1 and 21 exist at the time of its formation, regardless of preceding or subsequent semiconductor structures or steps in a process for preparing the semiconductor structure. *Cf., e.g., Exxon Chem. Pats.*, 64 F.3d at 1556-58 (“Consequently, as properly interpreted, Exxon’s claims are to a composition that contains the specified ingredients at any time from the moment at which the ingredients are mixed together.”).

Findings of Fact

We find Yamashita would have disclosed to one of ordinary skill in this art, as illustrated by embodiments depicted in Figures 3-8, a series of semiconductor structures. In the semiconductor structure illustrated in Figure 3, the layers are silicon (Si) substrate 21; silicon oxide (SiO₂) 22;

titanium (Ti) thin film 23; titanium nitride (TiN) thin film 24, providing a diffusion barrier between aluminum alloy (Al alloy) and SiO₂; Al alloy layer 25; Ti thin film layer 26; and TiN thin film layer 27, providing an anti-reflective layer. Yamashita ¶¶ 0031-32. In the semiconductor structure illustrated in Figure 4, SiO₂ film 28 is disposed on TiN thin film 27 and SiO₂ film 22; contact hole 29 is formed in SiO₂ film 28 with a resist pattern, with TiN thin film 27 providing an etch stop for a dry etch technique. Yamashita ¶ 0033. In the semiconductor structure illustrated in Figure 5, SiO₂ film 28 is a mask to etch TiN thin film 27 from the bottom of contact hole 29 using an RIE etch process. Yamashita ¶ 0034. In the semiconductor structure illustrated in Figure 6, TiN thin film 30 is disposed on SiO₂ film 28 and on Ti thin film 26 at the bottom of contact hole 29. Yamashita ¶ 0035. In the semiconductor structure illustrated in Figure 7, tungsten is disposed on TiN thin film 30 in contact hole 29, forming tungsten plug 31. Yamashita ¶¶ 0036-37. In the semiconductor structure illustrated in Figure 8, Al alloy film 32 is formed on TiN thin film 30 disposed on SiO₂ layer 28, and on tungsten plug 31 in contact hole 29, and TiN thin film 33 is formed on Al alloy film 32, wherein TiN thin film 33 and Al alloy film 32 can be resist patterned and etched with an RIE etch. Yamashita ¶¶ 0037-38.

Yamashita illustrates another semiconductor structure sequence in which TiN thin films function as etch stop layers, anti-reflective layers, and diffusion barriers between Al alloy and SiO₂. Yamashita ¶¶ 0021-28 and Figs. 1A-E; *see also* ¶¶ 0019-20.

We find Meikle would have disclosed to one of ordinary skill in this art that in the manufacture of semiconductor structures, TiAlN alloy is a

more effective diffusion barrier between a SiO₂ layer and an Al alloy layer than TiN; etches in similar manner to TiN in, for example, NH₄OH/H₂O₂; is more compatible with high temperature processes than TiN; can be used in a thinner layer than TiN for deposit in high aspect ratio contact holes; in thin films exhibits resistance as low or lower than TiN; and can be used as antireflective coatings on Si and SiO₂ layers in place of TiN. Meikle, e.g., abstract, col. 1, l. 29 to col. 2, l. 39, col. 4, ll. 27-32, col. 6, ll. 29-52, and col. 7, ll. 14-51. Meikle teaches that TiAlN alloy can replace TiN in semiconductor fabrication processes as well as in many applications in semiconductor devices. Meikle, e.g., abstract and col. 3, ll. 36-39.

Opinion

We have considered the totality of the record in light of Appellants' arguments with respect to claims 1 and 21 and the ground of rejection advanced on Appeal. *See, e.g., In re Kahn*, 441 F.3d 977, 985-86 (Fed. Cir. 2006) (“On appeal to the Board, an applicant can overcome a rejection by showing insufficient evidence of *prima facie* obviousness or by rebutting the *prima facie* case with evidence of secondary indicia of nonobviousness.”) (quoting *In re Rouffet*, 149 F.3d 1350, 1355 (Fed. Cir. 1998)); *In re Oetiker*, 977 F.2d 1443, 1445 (Fed. Cir. 1992) (“After evidence or argument is submitted by the applicant in response, patentability is determined on the totality of the record, by a preponderance of evidence with due consideration to persuasiveness of argument.”) (citing, *inter alia*, *In re Spada*, 911 F.2d 705, 707 n.3 (Fed. Cir. 1990)).

We are of the opinion Appellants have not established that the evidence in the combined teachings of Yamashita in view of Meikle does not

support the Examiner's conclusion of prima facie obviousness with respect to claims 1 and 21.

Claims 1 and 21

We cannot subscribe to Appellants' arguments that one of ordinary skill in this art would not have combined Yamashita and Meikle leading to the substitution of Meikle's TiAlN alloy for TiN in Yamashita's fabrication of semiconductor structures. Br. 3-5. We determine that this person would have had a reasonable expectation that the substitution of TiAlN alloy for TiN would result in the fabrication of semiconductor structures in the same or similar manner, and the resulting semiconductor structures would exhibit the same or similar properties as obtained with the use of TiN in light of the teachings of Meikle that the same and similar fabrication results and properties would be obtained. Indeed, Yamashita's process reasons for using TiN thin layers in the fabrication of the semiconductor structures illustrated in Yamashita Figures are the same process steps for which Meikle teaches the substitution of TiAlN alloy for TiN. Thus, one of ordinary skill in this art routinely following the combined teachings of Yamashita and Meikle would have reasonably arrived at Yamashita's semiconductor structures illustrated in Yamashita Figures 7 and 4 which fall within appealed claims 1 and 21, respectively. *See above* pp. 4-6. *See, e.g., KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 417 (2007) (a patent claiming a combination of elements known in the prior art is obvious if the improvement is no more than the predictable use of the prior art elements according to their established functions); *In re Sovish*, 769 F.2d 738, 742-43 (Fed. Cir. 1985) (skill is presumed on the part of one of ordinary skill in the

art); *In re Keller*, 642 F.2d 413, 425 (CCPA 1981) (“The test for obviousness is . . . what the combined teachings of the references would have suggested to those of ordinary skill in the art.”); *In re Siebentritt*, 372 F.2d 566, 567-68 (CCPA 1967) (express suggestion to interchange methods which achieve the same or similar results is not necessary to establish obviousness); *see also, e.g., Pfizer, Inc. v. Apotex, Inc.*, 480 F.3d 1348, 1364 (Fed. Cir. 2007) (“the expectation of success need only be reasonable, not absolute”); *In re O’Farrell*, 853 F.2d 894, 903-04 (Fed. Cir. 1988) (“For obviousness under § 103, all that is required is a reasonable expectation of success.” (citations omitted)).

Thus, on this record, semiconductor structures of Yamashita Figures 7 and 4 containing TiAlN alloy layers in place of TiN layers as taught by Meikle are identical or substantially identical to the claimed semiconductor structures of appealed claims 1 and 21. Indeed, with respect to claim 21, Yamashita discloses a TiN layer as an etch stop layer and Meikle teaches that TiAlN alloy and TiN behave in the same or similar manner in this respect, contrary to Appellants’ arguments. Br. 5; *see above* pp. 4-6.

With respect to claim 1, we agree with Appellants that the combination of Yamashita and Meikle does not disclose the use of TiN and TiAlN alloy layers as “polish stop” layers as claimed. Br. 4-5. Appellants submit that because Meikle does not disclose that a TiAlN alloy can be used as a polish stop layer as claimed in claim 1, one of ordinary skill in this art would not have been led to combine Yamashita and Meikle. Br. 4-5. Appellants’ contention overlooks the motivation to combine the references based on the process considerations for the substitution of TiAlN alloy for

TiN taught by Meikle. In this respect, it is sufficient if the disclosures of Yamashita and Meikle provide the motivation to one of ordinary skill in this art to combine their teachings even though it is not for the same function which Appellants disclose and claim for a TiAlN alloy layer. *See KSR*, 550 U.S. at 417-18 (*quoting Kahn*, 441 F.3d at 988) (“[A]nalysis [of whether the subject matter of a claim is obvious] need not seek out precise teachings directed to the specific subject matter of the challenged claim, for a court can take account of the inferences and creative steps that a person of ordinary skill in the art would employ.”); *In re Kemps*, 97 F.3d 1427, 1430 (Fed. Cir. 1996), *citing In re Dillon*, 919 F.2d 688, 693 (Fed. Cir. 1990) (*en banc*) (motivation in the prior art to combine the references does not have to be identical to that of applicant to establish obviousness); *In re Beattie*, 974 F.2d 1309, 1312 (Fed. Cir. 1992) (“As long as some motivation or suggestion to combine the references is provided by the prior art taken as a whole, the law does not require that the references be combined for the reasons contemplated by the inventor.”); *In re Kronig*, 539 F.2d 1300, 1304 (CCPA 1976) (The reference provides “ample motivation to add water in order to increase product yields, and we do not view the rejection as deficient merely because appellants allege a different advantage resulting from the addition of water. Obviousness under 35 U.S.C. § 103 does not require absolute predictability, and it is sufficient here that [the reference] clearly suggests doing what appellants have done.” (citations omitted)).

Furthermore, the fact that the combined teachings of Yamashita and Meikle do not describe the properties of the TiAlN alloy layer as a “polish stop layer” does not establish the patentability of claim 1. *See, e.g., In re*

Skoner, 517 F.2d 947, 950-51 (CCPA 1975) (“Appellants have chosen to describe their invention in terms of certain physical characteristics Merely choosing to describe their invention in this manner does not render patentable their method which is clearly obvious in view of [the reference].” (citation omitted)). Indeed, it is well settled that Appellants’ discovery of a new property of a product known in the prior art will not, without more, be dispositive of the nonobviousness of the claimed product over the known product. *See, e.g., Spada*, 911 F.2d at 707, and cases cited therein; *Skoner*, 517 F.2d at 950-51.

Thus, on this record, Appellants have not patentably distinguished the claimed semiconductor structures encompassed by claims 1 and 21 over the combined teachings of Yamashita and Meikle.

Conclusion

Accordingly, based on our consideration of the totality of the record before us, we have weighed the evidence of obviousness found in the combined teachings of Yamashita and Meikle with Appellants’ countervailing evidence of and argument for nonobviousness, and based thereon we conclude, by a preponderance of the evidence and weight of argument, that the claimed invention encompassed by appealed claims 1 through 5, 7, and 21 would have been obvious as a matter of law under 35 U.S.C. § 103(a).

The Primary Examiner’s decision is affirmed.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a)(1)(v).

Appeal 2009-004931
Application 09/905,398

AFFIRMED

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